

DOCUMENT RESUME

ED 322 359

CE 055 481

TITLE Small Engines and Outboard Marine Mechanics Curriculum.

INSTITUTION Alaska State Dept. of Education, Juneau. Div. of Adult and Vocational Education.

PUB DATE 88

NOTE 76p.

PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC04 Plus Postage.

DESCRIPTORS *Competence; *Competency Based Education; *Course Content; Course Descriptions; *Curriculum Development; Educational Resources; Engines; Marine Technicians; Postsecondary Education; Secondary Education; Skilled Occupations; *Small Engine Mechanics; State Curriculum Guides; Teacher Role; Vocational Education Teachers

IDENTIFIERS *Alaska; *Marine Equipment

ABSTRACT

This competency-based curriculum guide is a handbook for the development of small engine and outboard marine mechanics programs. Based on a survey of Alaskan small engines and marine mechanics employers, it includes all competencies a student should acquire in such a mechanics program. The handbook stresses the importance of understanding the principles associated with the various components of small engines and outboard marine mechanics. Units begin with definitions of terms and principles so that students will have conceptual frameworks upon which they may develop a complete perspective for working in the field. The handbook is organized in these seven sections: (1) the concept of competency-based curriculum and the role of vocational educators in curriculum planning, implementation, and evaluation; (2) the hierarchy of small engines and outboard marine mechanics competencies; (3) competencies and tasks for the following subjects--employability skills, laboratory safety and shop procedures, tools and equipment, internal combustion engines, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, and marine engines and boat rigging; (4) course descriptions to assist school districts in developing their vocational programs; (5) curriculum analysis matrices to be used to determine competencies for specific small engines and outboard marine mechanics courses; (6) a sample skills card for evaluating and recording student progress; and (7) information on resources and specific materials available in Alaska and the rest of the nation. (KC)

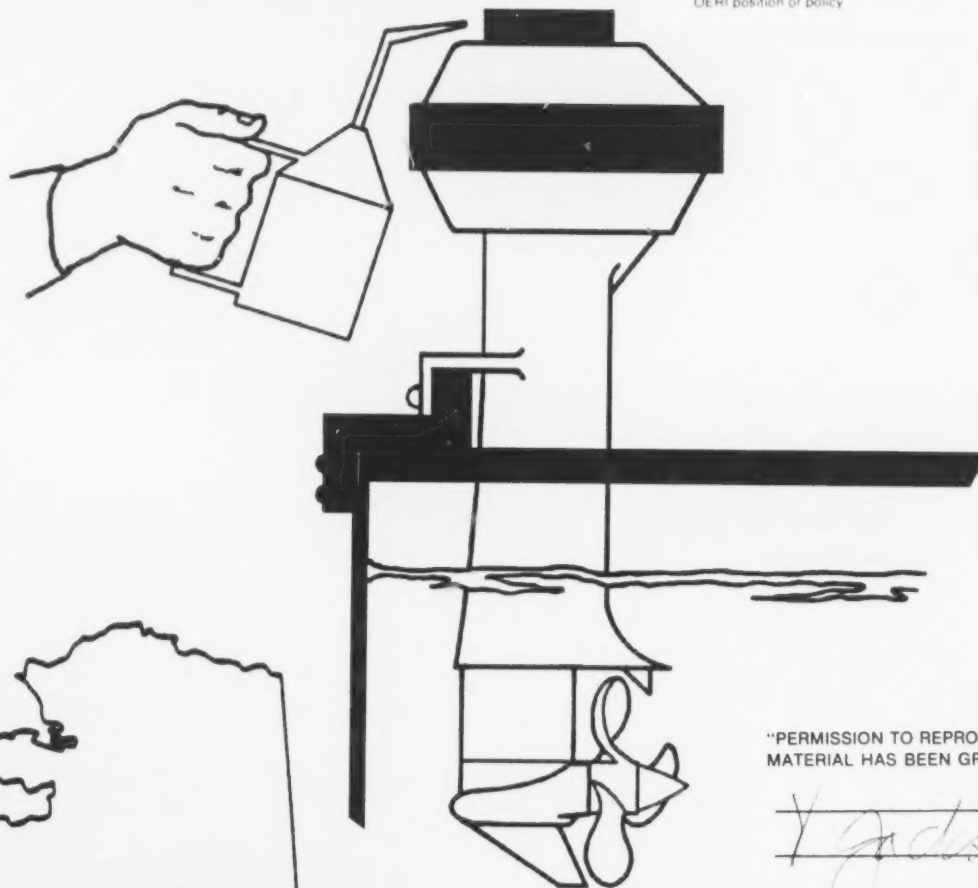
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

Small Engines and Outboard Marine Mechanics Curriculum

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☒ This document has been reproduced as
received from the person or organization
originating it.
☐ Minor changes have been made to improve
reproduction quality.

• Points of view or opinions stated in this docu-
ment do not necessarily represent official
OERI position or policy.



"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

J. Jackson

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

Alaska Department of Education 1988

Small Engines and Outboard Marine Mechanics Curriculum

State of Alaska
Steve Cowper, Governor

Developed by the:
Alaska Department of Education
Office of Adult and Vocational Education

William G. Demmert, Commissioner

Karen Ryals, Administrator,
Office of Adult and Vocational Education

This publication was prepared with the support of U.S. Department of Education funds under the Carl Perkins Vocational Education Act, PL98-524. Copies are available from the Alaska Department of Education, Office of Adult and Vocational Education, Alaska Vocational Materials Library, Box F, Juneau, Alaska 99811, (907)465-2980. This publication may be duplicated.



Alaska Department of Education 1988

The Alaska Department of Education is an equal opportunity employer and will not discriminate in Department employment, supervision, practices, services or educational programs on the basis of race, religion, color, national origin, age, sex, handicap, marital status, changes in marital status, pregnancy, parenthood, veteran's status, veteran's disability or political affiliation.

Table of Contents

Foreword	i
Acknowledgements	iii
I. Introduction to Competency-Based Curriculum	
Competency-Based Curriculum	3
Curriculum Delivery Systems	4
Role of Instructor in Curriculum Planning, Implementation, and Evaluation	4
II. Program Development	9
Hierarchy of Small Engines and Outboard	
Marine Mechanics Competencies	10
III. Competencies and Tasks	
<u>Basic Competencies</u>	
Employability Skills	13
Laboratory Safety and Shop Procedures	19
Tools and Equipment	23
Fundamentals of Internal Combustions Engines	25
<u>Engine Service Competencies</u>	
Engine Design and Structure	27
Cooling and Lubrication Systems	29
Fuel Systems	31
Electrical Systems	33
Exhaust and Emissions	37
Engine Overhaul/Repair	39
Troubleshooting and Maintenance	43
Power Transmissions	45
Brakes and Safety	47
Marine Engine and Boat Rigging	49
IV. Course Descriptions	55
V. Curriculum Analysis Matrices	59
VI. Sample Skills Card	69
VII. Suggested Resources	73

Foreword

This competency-based curriculum is designed to be a handbook for the development of small engine and outboard marine mechanic programs. It includes all competencies a student will acquire in such a mechanics program. Development of this handbook began with a survey of Alaskan small engines and marine mechanics employers. Their priorities regarding the skills and knowledge students need to acquire to survive and thrive in the industry form the basis of this handbook.

The handbook stresses the importance of understanding the principles associated with the various components of small engines and outboard marine mechanics. Units begin with definition of terms and principles so that students will have conceptual frameworks to which they may develop a complete perspective for working in the field. The fourteen units, basic and engine service competencies, are fundamental to understanding the small engines and outboard marine mechanics industry. The competencies and tasks are presented so that instructors have the prerogative to determine which aspects they want to teach in basic and advanced level courses.

The handbook is organized into seven sections:

Section I introduces the concept of competency-based curriculum. The role of vocational educators in curriculum planning, implementation, and evaluation is also included.

Section II provides the hierarchy of small engines and outboard marine mechanics competencies.

Section III presents the curriculum including the competencies and tasks for small engines and outboard marine mechanics.

Section IV contains course descriptions to assist school districts in developing their vocational programs.

Section V provides curriculum analysis matrices to be used to determine competencies to be included in specific small engines and outboard marine mechanics courses.

Section VI contains a sample skills card for evaluating and recording student progress.

Section VII lists information on resources and specific materials available in Alaska and the rest of nation.

It is recommended that all students participate in career awareness and exploration experiences to help them understand the connection between school and work and make career plans.

Acknowledgements

This handbook reflects the competencies needed for entry-level employment due to the input of Alaskan small engines and marine mechanics professionals. Thanks and recognition go to the following technical committee members for their assistance and cooperation:

A to Z Auto Marine and Machine Shop, Juneau
Frery's Outboard Repair, Juneau
Niniichik V.I.G. Auto and Boat, Niniichik
Oceanside Auto and Marine Salvage, Soldotna
Operating Engineers Apprenticeship Program, Anchorage
R & P Small Engine Repair, Fairbanks
Starkey Auto and Small Engines, Fairbanks
Valley Small Engine Clinic, Juneau

A task force of Alaskan educators in small engines and marine mechanics helped to define the units, competencies, and tasks. The task force which met to finalize this handbook deserve a great deal of credit for their hard work and valuable input:

Michael Anderson, Alaska Department of Education
Bob Boyle, Bering Straits School District, Unalakleet
Bill Brandner, Juneau Douglas High School, Juneau
Russ Cropley, Alaska Department of Education, Juneau
Neal Lacy, Matanuska-Susitna Community College, Wasilla
Rick Tarpey, Alaska Vocational Technical Center, Seward
Steve Vieira, Sitka High School, Sitka

Special appreciation is expressed to Carin Smolin and Richard Steele, who coordinated the preparation and completion of this handbook, and to Mark Hanson, Associate Director of the South East Regional Resource Center, who administered this project.

Special thanks are also due South East Regional Resource Center employees Ginger Murar and Dave Wood who designed the graphics for the handbook.

Thanks also go to the National Network for Curriculum Coordination in Vocational and Technical Education (NNCCVTE) and participating states for providing resource materials which improved the quality of this handbook and saved months of work.

Finally, Verdell Jackson, Curriculum Specialist for the Office of Adult and Vocational Education, must be recognized for designing the process and participating in every step of the handbook's development ensuring that it is a model Alaskan curriculum of the highest quality.

Karen Ryals
Administrator
Office of Adult and Vocational Education
Alaska Department of Education
November 1988

Introduction to Competency-Based Curriculum

Competency-Based Curriculum

Vocational education should be directed toward the skills, knowledge, and attitudes needed for successful employment. Mechanics educators need to continually update their curriculum in order to prepare students for competition in the job market.

An effective method for delivering vocational education is through a competency-based curriculum. This curriculum is based on a task analysis of the key occupations in small engines and outboard marine mechanics. Once a competency-based curriculum is set in place, student performance must be measured on levels of proficiency in those competencies. Thus, the critical features of competency-based education are:

- 1) validating competencies to be included in the curriculum; and
- 2) evaluation of student competency levels.

This curriculum handbook sets direction for local curriculum developers. It provides a framework for developing courses of study and lesson plans in local schools.

Curriculum Based On Competencies

Competence refers to the adequate performance of a task. The task may be evaluated according to the performance or process, the service, or both.

Competency-Based Vocational Education consists of programs that derive their content from the tasks performed in each occupation/job and assess student performance on the basis of preset performance standards.

Learning materials define the competencies the student is to master, the criteria by which the student will be evaluated, and the conditions under which the evaluation will occur.

Competency-based instruction places emphasis on the ability to do, as well as on learning how and why. Student performance and knowledge are individually evaluated against the stated criteria, rather than against group norms.

The competency process utilizes a checklist of attitudes, knowledge, and skills that are commonly needed by entry-level employees in small engines and marine mechanics occupations. In developing this curriculum handbook, a cross-section of mechanics professionals were asked to respond to a survey on the basis of needs within their own establishments. The survey results were summarized to determine which attitudes, knowledge, and skills were important to firms in Alaska.

Student Performance Assessment

A curriculum becomes competency-based when students are assessed on the basis of their competence. Sample skill cards are provided in this guide for teachers who wish to use them in assessing the competency levels of their students. The card has four levels of proficiency which allow continued development of skills. The card can be used to monitor students' progress as they move between tourism classes, between teachers and grade levels, and between school and work. The completed skills card is an important part of a placement portfolio when students begin their job searches.

Curriculum Delivery Systems

Vocational Student Leadership Organizations

Some of the competencies in this curriculum guide cannot be fully met in traditional classroom and lab settings. The Vocational Industrial Clubs of America (VICA) is a delivery system which can be integrated into the regular school program. Human relations skills as well as job skills will be enhanced by student participation in VICA. VICA activities should complement instruction in the small engines and outboard marine mechanics classroom and lab. They should be integrated as a curriculum delivery system and not allowed to become an extracurricular activity.

Cooperative Work Experience

Some of the competencies identified in this guide cannot be fully developed at a school site. A work station in the community offers realistic experiences in fulfilling the program goals in career development and human relations. Cooperative Work Experience offers an excellent vehicle for the delivery of instruction. With well developed training plans, teachers and employers can cooperate to prepare students for employment. Cooperative Work Experience extends the instructional program beyond the availability of equipment and instructor time at the local school. Teachers and employers must maintain regular communications to assure that students are receiving a high quality experience.

The Rural Student Vocational Program (RSVP) provides a two week full-time work experience for students from rural areas where job stations are limited or non-existent.

The Job Training Partnership Act (JTPA) provides on-the-job experience to disadvantaged youth in both urban and rural areas.

Role of Instructor in Curriculum Planning, Implementation, and Evaluation

The vocational instructor fulfills many roles which include the following responsibilities:

- Prepares a written vocational program plan.
- Develops and maintains a written program philosophy with objectives that support the philosophy.
- Maintains a written list of competencies identified as needed for the program area.
- Devises and maintains a classroom management system for implementing the curriculum materials provided for the program area.
- Evaluates the curriculum content periodically to determine curriculum changes and updates. This includes the involvement of the students (present and former), advisory committee members, and other personnel.
- Selects units of instruction and plans lesson plans based on the competencies of the occupation.
- Provides appropriate instructional materials, supplies, and equipment for the students to use.

- Provides school guidance counselor with information and updates regarding implementation of the specific curriculum.
- Reviews the instructional materials to assure that they are free from sex bias and sex role stereotyping.
- Works with an advisory committee.
- Assists and/or serves as an advisor to the appropriate student organization related to the vocational program area.
- Plans and arranges an appropriate classroom learning environment. This involves assisting students of different abilities to work at their own pace and in cases where remedial instruction is needed, securing additional help for those students.
- Reinforces basic skills of reading, communication (written & oral), and computation through vocational education experiences.
- Helps determine what objective(s) should be established for handicapped students as a part of the individual educational plan (IEP) development.
- Uses a grading procedure that is made available to all students at the beginning of their training.
- Sets an example for grooming and dress that is generally found in the occupational area in business or industry to enable students to establish appropriate standards.

Benefits of the Competency-Based Curriculum

Competency-based vocational education offers several benefits to students:

1. The competencies/tasks are directed to the student and provide measurable criteria for determining when the student has acquired the necessary knowledge and skills.
2. Students receive realistic training for the job. They become competent in tasks that are relevant to the occupation.
3. Students know what is expected of them throughout the course. The competencies are made available to them at the onset. They know what they will be doing and how well it must be done.
4. Each student is individually responsible for completing each competency attempted in the curriculum.
5. The basic thrust of the competency-based program is to evaluate students according to their accomplishments of tasks as they work up to individual capability. Students are not compared with other students in their accomplishments because each is expected to work according to employment standards. Because of the various evaluation policies of different school systems, the ideal of not comparing students in determining grades is not always possible.

II
Program
Development

Program Development

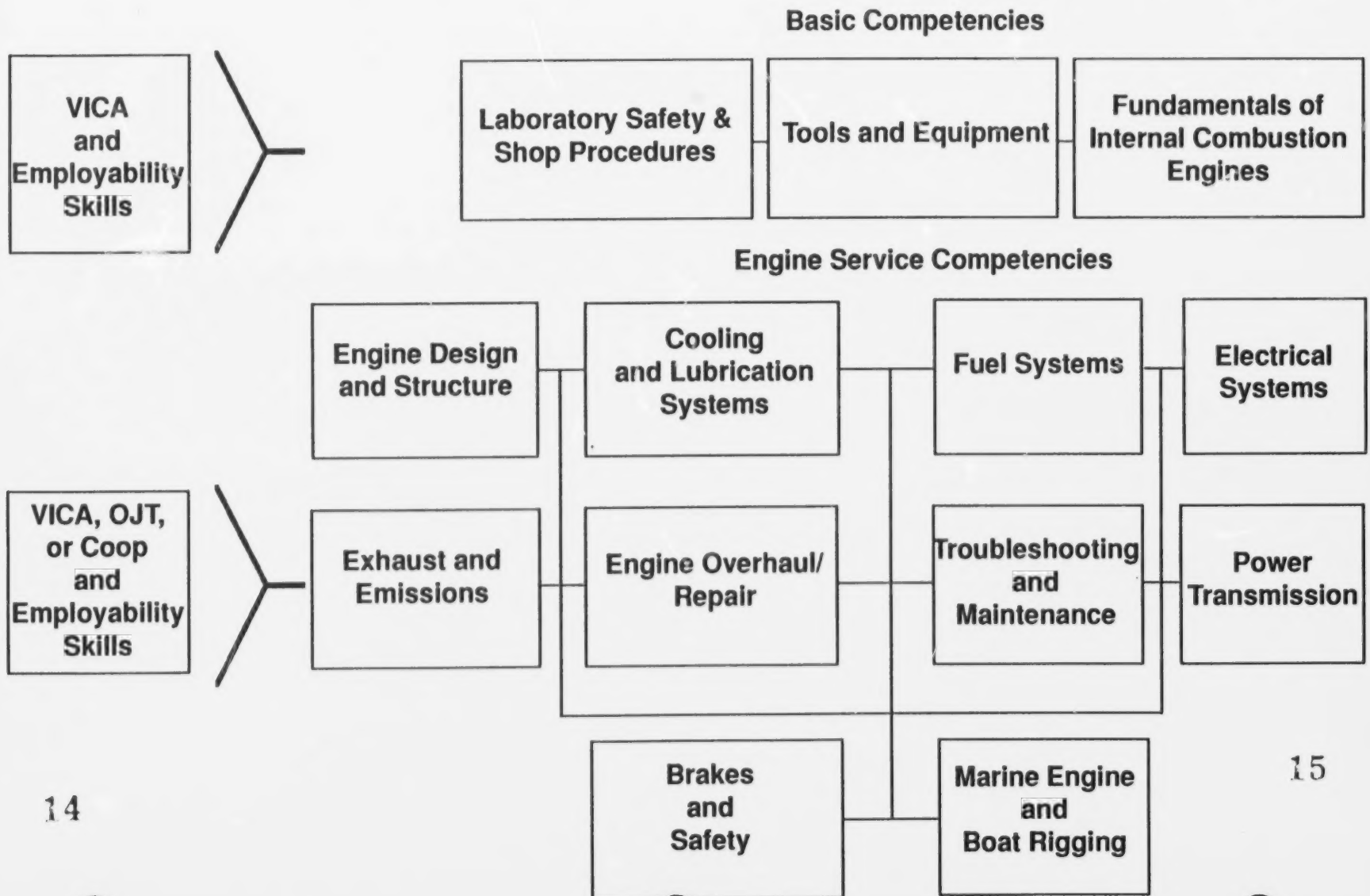
The format of this handbook was selected to aid administrators and teachers in concentrating on the skills needed for vocational training. It will assist in selecting the array of units and the delivery system which fit the school. This provides the flexibility of varying the course content to include the most valuable skills as appropriate for the scope and sequence. The primary importance is that students are able to secure foundation skills. Schools can vary their delivery systems to maximize student opportunities by:

1. Offering courses on alternate years or other planned sequences
2. Offering two or more courses in the same class
3. Providing individualized materials and instruction

A matrix is included in this guide for use in planning the courses to be offered and the content of each course.

The following chart shows the hierarchy of small engines and outboard marine mechanics competencies.

Hierarchy of Small Engines and Outboard Marine Mechanics



III

Competencies and Tasks

Employability Skills



Competency:

Make career choices

Tasks:

Conduct a self-assessment:

- a. assess values in relation to work
- b. recognize skills and aptitudes
- c. assess employment history and experience
- d. describe obstacles to employment
- e. use Alaska Career Information System and other career counseling systems and publications

Identify career clusters:

- a. list specific jobs and duties within clusters
- b. describe apprenticeship/training programs
- c. describe advanced training opportunities

Use labor market information:

- a. describe the current local labor market
- b. identify growth/demand occupations
- c. relate career choices to local labor market

Select a career goal:

- a. list how skills could be used in other jobs
- b. develop specific steps to reach goals

Competency:

Evaluate jobs in the small engine and outboard marine mechanics industry

Tasks:

Identify educational and occupational opportunities such as:

- a. adult, postsecondary vocational training
- b. special grants from industry
- c. federal, state and local funding

Locate resources for finding employment

Confer with prospective employers

Explain the work of a(an):

- a. small engine technician
- b. marine technician
- c. parts shop salesperson
- d. manufacturers technical representative
- e. computer parts inventory technician

Competency:

Prepare a resume and job application

Tasks:

Obtain a social security number

List :

- a. past and present work experience
- b. hobbies and interests
- c. community activities or memberships
- d. in-school activities or memberships
- e. awards, positions, or club offices
- f. adult references, including addresses and phone numbers

Obtain extra copies

Read job applications carefully

Follow instructions

Complete all items accurately

Write legibly

Verify references before listing them

Competency: Write a cover letter

Tasks: Explain when and how to write a cover letter
Explain what a writing sample tells a potential employer
List the things the cover letter must include

Competency: Prepare for an interview

Tasks: Contact an employer to schedule an interview
Describe questions and responses asked in an interview
Use proper etiquette for an interview
Dress appropriately for an interview

Competency: Follow up the interview

Tasks: Analyze the interview
Determine whether a follow-up letter or call is required
Write a thank-you note or make a follow-up call

Competency: Dress appropriately on the job

Tasks: Identify proper attire for small and marine engine technician jobs
Be neat and clean

Competency: Manage personal responsibilities related to employment

Tasks: Secure adequate transportation
Identify adequate child care alternatives
Secure appropriate child care
Use independent living skills
Develop a personal finance plan

Competency: Maintain good health for effective job performance

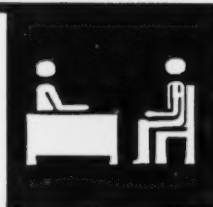
Tasks: Exercise regularly
Eat properly
Get adequate rest
Explain the issue of smoking on the job
Refrain from drug abuse
Identify the hazards of job-related infectious diseases and how to avoid them

Competency: Understand employee rights and responsibilities

Tasks: Explain state labor laws relating to compensation
Complete tax forms
Describe:
 a. minimum wage and types of exempt businesses
 b. employee benefits, rights and responsibilities
 c. labor contracts, grievance procedures and the role of unions
Describe a sample personnel policy

Competency: Deal effectively with customers

Tasks: Greet the customer
Talk politely to customer
Obtain all necessary information from customer in writing
Identify the business on the telephone
Relay customer complaints to employer



Competency:

Attain work maturity

Tasks:

Describe the importance of openness to new situations

Demonstrate characteristics of the mature person:

- a. self-acceptance
- b. consideration and respect for others
- c. self-control
- d. positive thinking and attitudes
- e. flexibility
- f. initiative

Maintain good work relationships

Differentiate between personal and job-related problems

Follow orderly and systematic work behavior



Competency:

Solve problems

Tasks:

Explain the importance of having a method for analyzing and solving problems

Use the problem-solving process:

- a. identify problems
- b. obtain information
- c. analyze problems
- d. develop and analyze alternative solutions
- e. choose a course of action
- f. persevere through hardships
- g. recognize and change otherwise unworkable solutions

Competency:

Demonstrate initiative and productivity

Tasks:

Organize time effectively

Be responsible

Care about the quality of work

Complete assignments in accurate and timely manner

Handle pressures and tensions

Set priorities

Competency:

Be assertive

Tasks:

Differentiate between assertive, aggressive, and passive behavior

Identify whom to go to for employee problems

Competency:

Be honest

Tasks:

Define honesty and integrity

Explain how to deal with theft and dishonesty

Relate employee integrity to overall company performance

Recognize consequences of dishonesty

Competency:

Be reliable and dependable

Tasks:

Maintain acceptable attendance records

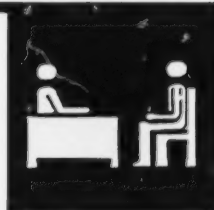
Be on time

Give timely notice of interruptions to work schedule

Follow rules and regulations of worker training site

Competency: Maintain good personal relations

Tasks: Use positive attitudes with others
Accept supervision and criticism
Cooperate with others
Accept chain of command
Follow the course of action to bring problems to the attention to management
Identify common on-the-job co-worker problems
Control emotions
Assume responsibility for own decisions and actions
Exhibit pride and loyalty



Competency: Apply reading and writing skills

Tasks: Read technical journals
Use technical vocabulary
Locate information in trade and consumer magazines and supply catalogs
Write work orders, parts orders, and warranty reports
Locate and correct errors in spelling, grammar, and punctuation
Compose business letters
Transfer written messages to others verbally and in written form
Use good penmanship
Use proper telephone etiquette

Competency: Follow verbal and written directions

Tasks: Ask for clarification
Use listening skills
Review situations of poor communications
Read directions when assembling and repairing equipment

Competency: Demonstrate on-the-job growth

Tasks: Be aware of current products and service technology
Be aware of job progression and opportunities
Identify performance evaluation content
Evaluate further education options through the company

Competency: Use proper job resignation procedures

Tasks: Write a letter of resignation
Make final settlements (in regards to retirement, physical injury, social security, severance pay, etc.)

Competency: Use leadership skills

Tasks: Describe the Vocational Industrial Clubs of America (VICA) and how it teaches leadership skills:

- participate in meetings according to rules of parliamentary procedure
- function effectively on committees by accepting assigned responsibilities
- plan and conduct effective group leadership activities
- participate in society in a democratic way
- be punctual and dependable
- follow rules, standards and policies
- work cooperatively with others

Explain importance of self-esteem
Practice eye contact
Use a firm handshake
Use presentation skills
Use communication skills
Participate in leadership activities



Competency:

Evaluate personal traits in relationship to self-employment

Tasks:

Explain terms and principles associated with entrepreneurship
Describe the role of self-employment in the free enterprise system
Identify types of business organizations including:
 a. sole proprietorship
 b. limited partnership
 c. partnership
 d. corporation
Identify personal traits necessary for self-employment
Identify risks and rewards of starting a new business
Identify the role small businesses have played in job creation and new products and services
Identify the steps for establishing a business
Explain the importance of developing a business plan
Locate information and assistance on starting a small business

Laboratory Safety & Shop Procedures



(A) Indicates advanced competency or task

Competency: Understand need for safety

Tasks:

- Explain the need for safety
- Identify components of a fire triangle and the effects of water, oil, and other flammable liquids
- Locate and operate a fire extinguisher
- Specify what to do in case of an emergency or accident
- Practice safety habits and pass a written safety test
- Secure small engines before test running them in the shop
- Replace protective guards on chains, gears, shafts, or flywheels before operating engines
- Use repair and service manuals

Competency: Understand the organization of the laboratory

Tasks:

Identify:

- a. laboratory operation policies
- b. location of laboratory equipment and materials
- c. safety hazards
- d. traffic patterns
- e. work storage areas/work stations
- f. location of emergency assistance and first-aid stations and fire exits

Competency: Use general safety procedures

Tasks:

Follow safety rules for:

- a. maintaining a safe orderly shop
- b. preventing accidents and injuries
- c. applying first-aid
- d. handling flammable metals

Use safety equipment in the laboratory
Demonstrate general shop and personal safety
Keep a clean, orderly, and safe working area

Competency: Use chemicals safely

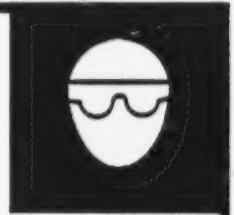
Tasks:

Identify the use of hazardous, caustic, and toxic chemicals such as:

- a. flammable liquids and solids
- b. asbestos
- c. acid
- d. caustics - lyes, sodium hydroxide, steam cleaning fluids, floor cleaners
- e. poisonous liquids
- f. hazardous wastes and carcinogens
- g. hazardous fumes

Competency: **Use laboratory equipment safely**

Tasks: Explain proper use and operation of stationary and portable equipment
Identify faulty equipment
Explain reporting procedures for faulty equipment



Competency: **Use tools safely**

Tasks: Explain importance of using tools safely
Identify safety measures such as keeping hands, clothing, tools, and other objects away from moving parts while running small engines.
Select tools appropriate to each project
Follow directions and procedures for specific work activities as given by the instructor, textbook, manual specifications or plans
Utilize tools in prescribed manners including:
 a. using the proper tool for the task at hand
 b. clamping projects securely before drilling or power grinding
 c. using the correct speed for power tools and drill bits when working with metal
 d. using properly sharpened tools and drill bits
 e. using extension cords
 f. using air hoses

Competency: **Maintain a clean shop**

Tasks: Perform assigned shop cleanup duties
Keep floors and workbenches clean and neat
Wipe oil and grease spots immediately
Keep rags in self-closing metal container
Place scrap materials in proper containers or locations
Clean and replace all tools to cabinets, racks and other storage locations
Keep aisles, traffic areas, and exits free of materials and other debris

Competency: **Follow OSHA guidelines**

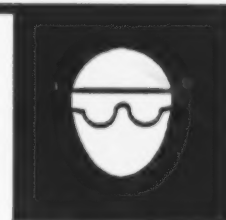
Tasks: Explain the purpose of the Occupational Safety and Health Act (OSHA)
Identify material safety sheets and their location in shop
Identify worker rights under OSHA
Explain how to resolve hazardous and OSHA violation situations

Competency: **Prevent work-related injuries**

Tasks: Describe the importance of safe working attitudes
Report injuries and accidents no matter how slight
Wear protective gear including:
 a. hat or net to restrain long hair
 b. eye and ear protection
 c. respirators or filter masks
 d. gloves
 e. chaps
 f. long sleeves
 g. boots and steel-toed boots
 h. shop garments

Follow safety procedures for:

- a. lifting
- b. working on fuel supply tanks
- c. inflating tires
- d. noise abatement
- e. driving
- f. working in enclosed areas



Competency: Perform general shop duties

Tasks: Take in and check out repair work
Maintain tool and equipment inventory
Maintain inventory cards
Read mechanics publications

Competency: Perform service and business procedures

Tasks: Fill out a work order
Identify engine model, type and serial number
Identify parts needed from a parts manual
Use parts interchange manual
Obtain parts
Complete a parts sales slip
Write service reports
(A) Perform sales and service selling techniques
(A) Evaluate personnel time management
(A) Determine employee productivity
(A) Estimate repair costs

Tools and Equipment

(A) Indicates advanced competency or task



Competency: Use hand tools

Tasks:

Identify and demonstrate the proper use of tools such as:

- | | |
|------------------------|--------------------------|
| a. hammers | j. pullers |
| b. chisels and punches | k. reamers |
| c. drivers | l. socket sets |
| d. pliers | m. locking devices |
| e. drill bits | n. stud extraction tools |
| f. grinders | o. taps and dies |
| g. files | p. torque wrenches |
| h. clamps | q. wrenches |
| i. screwdrivers | |

Maintain tools by:

- sharpening drill bits
- sharpening chisels, punches, and screwdrivers
- tightening or replacing handles
- checking torque wrench for accuracy
- cleaning tools
- dressing a grinding wheel

Competency: Use power tools

Tasks:

Identify and demonstrate the safe operation of:

- electric tools and equipment
- pneumatic tools and equipment
- electric stationary equipment such as:
 - drill press
 - grinders

(A) Demonstrate the safe operation of boring machines

Competency: Operate oxy-acetylene equipment

Tasks:

Explain terms and principles associated with oxy-acetylene equipment including:

- types of gases
- flames
- tip types and sizes
- safety equipment
- torch adjustments
- pressure settings

Safely set up and secure oxy-acetylene torches

Use oxy-acetylene equipment for:

- heating
- cutting

Competency: Use fasteners, gaskets, sealants, and adhesives

Tasks: Explain the use, classification, and sizes of fasteners
Explain the proper application of gaskets, sealants, and adhesives
Explain the proper procedure for the removal and tightening of fasteners
Identify the function of types of nuts used in small engines



Competency: Perform thread repair

Tasks: Chase threads
Extract broken fasteners
Drill and tap holes
(A) Repair damaged threads using a thread repair procedure

Competency: Use measuring devices

Tasks: Identify terms associated with measuring including:

- a. scale
- b. graduation
- c. tolerance
- d. fits
- e. reference point

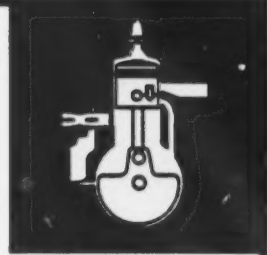
Identify the use of:

a. bore gauges	j. pressure gauge
b. caliper	k. small hole gauge
c. coil tester	l. steel rule
d. dial indicator	m. tachometer
e. drill gauges	n. telescoping gauges
f. electrical test equip.	o. thread pitch gauge
g. feeler gauges	p. timing light
h. micrometer	q. vernier instruments
i. multimeter	r. vacuum gauges

Competency: Apply mathematic and measurement fundamentals

Tasks: Explain the importance of math and measurement
Use measurements related to work on small engines

Fundamentals of Internal Combustion Engines



Competency: Identify parts of the small engine

Tasks: Disassemble a small engine
Recognize the parts of a small engine
Reassemble the small engine
Start the engine

Competency: Understand engine classification and applications

Tasks: Explain the different types of small engines
Explain how engines are classified by type, size, and manufacturer
Explain the different ways engines are classified such as:

- a. internal/external combustion engines
- b. fuels: gasoline, diesel, propane
- c. two-cycle, four-cycle, rotary
- d. displacement

Explain the application of engines such as:

- a. outboards
- b. generators
- c. ATV's

Competency: Understand the operation of the internal combustion engine

Tasks: Explain terms and principles associated with internal combustion engines including:

- a. expansion of solids, liquids, and gases as they are heated
- b. the triangle of combustion
- c. how a controlled explosion obtains useful power
- d. atmospheric pressure and vacuum

Explain how high pressure in the engine cylinder causes a piston to move
Explain how motion is changed to rotary motion
Explain the sequences, activities, and events taking place in an internal combustion engine
Contrast the operating cycles of two- and four-cycle engines
Explain the need for cooling, lubrication, fuel, ignition, and exhaust systems

Competency: Understand the operation of small diesel engines

Tasks: Explain terms and principles associated with small diesel engines including:

- a. governor
- b. fuel pumps
- c. injectors/injector pumps
- d. glow plug
- e. pre-combustion chamber

Compare and contrast the differences between compression and spark ignition systems
Describe the operation of the fuel injection system in diesel engines
Explain the operation of the four-cycle diesel engine

Competency:

Understand engine operating systems

Tasks:

Explain fuel systems such as:

- a. fuel tanks
- b. venting
- c. fuel lines
- d. fuel pumps
- e. carburetion/fuel injection

Identify lubrication systems for small engines including:

- a. oil supply container
- b. oil pumps/splashes
- c. grease fittings

Explain ignition systems including:

- a. points and condensor
- b. electronic systems
- c. computerized systems

Explain cooling systems such as:

- a. liquid
- b. air
- c. combinations of liquid and air

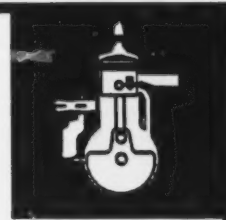
(A) Competency:

Understand engine measurement and performance

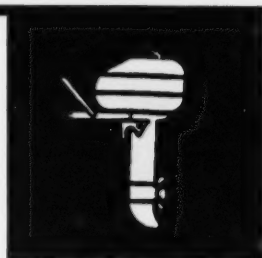
Tasks:

Explain terms and fundamental principles associated with mechanical power and its production including:

- a. efficiency/work/energy
- b. horsepower
- c. PSI (Pounds per square inch)
- d. compression ratio
- e. torque



Engine Design and Structure



Competency: Understand the operation of the piston, connecting rod, and crankshaft assembly

Tasks: Explain terms and principles associated with the piston, connecting rod, and crankshaft assembly including:

a. piston head	k. bearings and retainers
b. piston pin	l. piston composition
c. skirt	m. match marks
d. pin hole	n. main bearing journals
e. ring grooves	o. connecting rod journals
f. ring side clearance	p. counterweights/balance
g. skirt clearance	q. keys and keyways
h. retaining ring	r. lock plate
i. connecting rod	s. snout
j. flywheels	

Explain differences in piston and crankshaft designs between two and four stroke engines

Explain the transfer of energy from a chemical reaction to mechanical energy

Explain the transition from reciprocating motion to rotary motion

Competency: Understand the operation of the valve train

Tasks: Explain terms and principles associated with valves including:

a. margin
b. seat
c. stem
d. face
e. retainer
f. head
g. stem

Explain terms and principles associated with valve trains including:

a. adjusting nut
b. tappet guide
c. camshaft
d. cam lobes/eccentrics
e. head
f. valve guide
g. valve spring
h. clearance
i. lock nut
j. tappet
k. push rods
l. rocker arms
m. timing gears and chains

Explain the relationship between the valve train and operation of the engine

Competency: Understand the operation of the two-stroke induction system

Tasks: Explain terms and principles associated with two-stroke induction systems including:

a. rotary valve
b. reed valve
c. piston port (transfer channel)
d. loop scavenging versus cross scavenging

Explain intake, power, and exhaust cycles of the two-stroke system

Explain the difference in efficiency between two and four-stroke engines



Competency:

Understand the function of the cylinder block assembly

Tasks:

Explain terms and principles associated with the cylinder block and head including:

- a. block
- b. block material
- c. cooling systems
- d. cylinder and sleeves
- e. head bolts
- f. head gasket
- g. head types and construction
- h. induction system passages
- i. main bearing and capstan supports
- j. lubrication systems
- k. ports
- l. engine mounting systems
- m. expansion plugs

Explain the difference in block and head design between two and four stroke engines

Cooling and Lubrication Systems

(A) Indicates advanced competency or task



Competency: Understand engine cooling systems

Tasks: Explain the components and functions of air-cooled systems including:

- a. flywheel
- b. filter screen
- c. blower shroud
- d. cylinder head baffle
- e. cylinder baffle
- f. air deflector
- g. thermostat

Explain the components of liquid-cooled systems including:

- a. radiator
- b. water pump
- c. water jacket
- d. fan
- e. thermostat
- f. pressure cap
- g. radiator hose
- h. fan belt

Describe the purpose of engine cooling systems

Describe types of cooling systems:

- a. air
- b. liquid

Explain the purpose of pressurizing the liquid cooling system

Explain the purpose of oil and fuel in cooling

Competency: Service air cooling systems

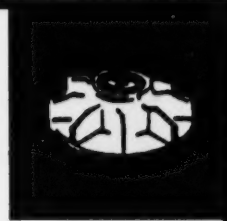
Tasks: Inspect cooling system components
Adjust/replace belts
Clean air fins
Check for obstructions

Competency: Service liquid cooling systems

Tasks: Inspect cooling system components
Test pressure cap
Pressure test cooling system for leaks
Perform combustion leakage test
Test and add coolant
Replace hoses
Adjust/replace belts
Check thermostat and by-pass housing
Clean exterior components
Inspect engine oil and transmission fluid coolers
Inspect cooling warning light system and gauges
(A) Inspect water pump for bearing condition and water leaks
(A) Use pressure test, fluid gas detector, and infra-red testers

Competency: **Inspect outboard water pumps**

Tasks: Explain how the water pump circulates water
Start the engine
Check for water circulation
Check for system obstructions, both inlet and outlet
Repair/replace pump



Competency: **Understand engine lubrication**

Tasks: Identify terms and principles associated with engine lubrication such as:
 a. friction
 b. heat
 c. oil viscosity
 d. oil classification/ratings
Identify uses of lubricants such as:
 a. dry
 b. liquid
 c. paste
Describe the effects of lubrication system failures
Contrast the properties of common small engine lubricating oils

Competency: **Service lubricating systems**

Tasks: Remove/replace lubrication system components including:
 a. filters d. PCV valve
 b. screens e. oil
 c. check valves
Troubleshoot lubrication component failure

(A) Competency: **Understand chassis lubrication and service**

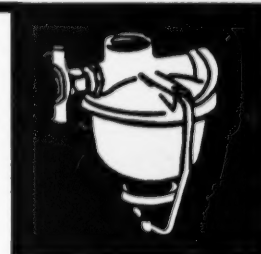
Tasks: Explain different types and ratings of lubricants used for chassis lubrication
Service a variety of bearing types including:
 a. ball bearings
 b. roller bearings
 c. needle bearings
 d. babbit or bushing bearings
 e. thrust washers or bearings
Troubleshoot bearing component failure in chassis

(A) Competency: **Service oil injection systems**

Tasks: Identify the different types of oil injection:
 a. mechanical type
 b. vacuum type
Repair and replace oil pump and time to engine operation

Fuel Systems

(A) Indicates advanced competency or task



Competency: Understand fuel systems

- Tasks:**
- Explain terms and principles associated with fuel systems including:
 - a. fuel types
 - b. fuel/oil mixtures
 - c. fuel storage/venting
 - d. fuel distribution and filtration
 - e. oil injection system
 - Describe the principles involved in:
 - a. fuel injection
 - b. carburetion
 - Explain the operation of gas (vapor) fuel systems including:
 - a. storage tanks, lines and fittings
 - b. regulators
 - c. carburetors

Competency: Understand carburetor systems

- Tasks:**
- Explain terms and principles associated with carburetor systems including:
 - a. butterfly float
 - b. slide float
 - c. butterfly diaphragm
 - d. constant velocity
 - e. classifications
 - Identify carburetor theory and circuitry
 - Identify the parts and functions of small engine carburetors including:
 - a. choke
 - b. throttle butterfly
 - c. venturi assembly
 - d. hi speed needle/orifice
 - e. slow speed needle
 - f. float or diaphragm metering
 - g. inlet needle valve
 - h. slide
 - Disassemble/reassemble and adjust small engine carburetors

Competency: Service fuel systems

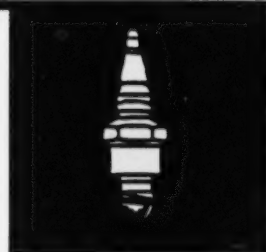
- Tasks:**
- Inspect, repair/replace:
 - a. fuel delivery system components
 - b. carburetion system components
 - (A) Inspect, repair/replace fuel injection system components

Competency: Service speed control devices

- Tasks:**
- Identify and adjust:
 - a. governors
 - b. remote controls
 - Adjust/repair throttle and/or shift controls

Electrical Systems

(A) Indicates advanced competency or task



Competency: Understand electricity and magnetism

Tasks: Explain terms and principles associated with electricity and magnetism including:

- | | |
|------------------|------------------------|
| a. current flow | i. resistance |
| b. electrons | j. fuse |
| c. conductor | k. circuitry |
| d. electromagnet | l. induction/coils |
| e. magnetism | m. integrated circuits |
| f. amperes | n. insulator |
| g. ampmeter | o. condenser/capacitor |
| h. voltage | |

Explain the function and operation of electrical component systems of small gasoline engines

Competency: Understand batteries

Tasks: Explain purpose, construction, and operation of batteries including:

- a. types
- b. voltage
- c. safety

Competency: Service batteries

Tasks: Explain terms and principles associated with battery service including:

- a. safety practices
- b. checking the battery and hold downs
- c. checking the electrolyte level (specific gravity) in all cells
- d. cleaning corrosion from battery terminals and top
- e. testing and diagnosing the condition of battery with tester
- f. recharging battery

Connect battery charger for charging and jump starting

Remove and replace battery/cables

Prepare battery for installation for:

- a. wet/dry
- b. maintenance free

Competency: Understand charging systems

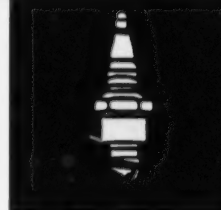
Tasks: Explain the components of the charging system

Explain how the following relate to small engine charging systems:

- a. alternators
- b. generators
- c. voltage regulators
- d. rectifiers
- e. transistors
- f. diodes
- g. relays
- h. volt/ampmeters

Competency: Service charging systems

Tasks: Repair and replace components
Use flywheel pullers and multimeters
(A) Troubleshoot charging system components



Competency: Understand breaker ignition systems

Tasks: Explain the function of the breaker ignition system
Explain the difference between a magneto-ignition system with breaker points and breakerless magneto-ignition system
Explain the function of the following ignition components:
a. spark plug
b. coil/transformer
c. points or sensor coil
d. condenser/capacitor
e. flywheel magnet
f. cam
g. flywheel key

Competency: Service breaker ignition systems

Tasks: Inspect primary and secondary ignition wiring
Inspect ignition mechanical advance controls
(A) Remove, test, and replace ignition circuit components

Competency: Understand the solid state ignition system

Tasks: Explain terms and principles associated with the solid state ignition system
Explain the operation and advantages of the solid state ignition system:
a. CDI ignition system
b. TCI ignition system
Explain the basic components of the solid state ignition system including:
a. trigger coils
b. CD module
c. rectifier
d. capacitor
e. secondary coil
f. SCR

Competency: Service solid state ignition systems

Tasks: Demonstrate:
a. ignition timing both statically and dynamically
b. troubleshooting sequence
c. the use of troubleshooting equipment

Competency: Understand starting systems

Tasks: Identify types of starters used on small engines
Explain operation of different types of mechanical and electrical starters
Explain purpose of starter drives and safety interlocks

Competency:

Service starting systems

Tasks:

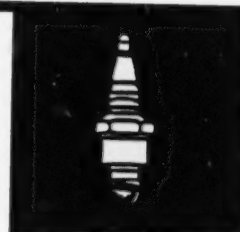
Adjust/maintain manual, mechanical, and electrical starters
Inspect starter systems
Remove and replace starter components
(A) Rebuild starter components

Competency:

Service engine timing

Tasks:

Explain terms and principles associated with engine timing such as:
a. timing marks
b. timing gears
c. timing chains
Explain the role of timing to the operation of small engines
Determine firing orders/cylinder numbering
Replace points and set gap



Exhaust and Emissions



Competency: Understand exhaust systems

Tasks: Identify the purposes of the exhaust system
Identify the terms and principles associated with the exhaust system for both 2 and 4-cycle engines including:

- a. pipes
- b. mufflers
- c. valves
- d. ports
- e. manifold
- f. header
- g. spark arrester

Identify applications of different types of mufflers and tuned exhaust systems

Competency: Understand safety and environmental concerns

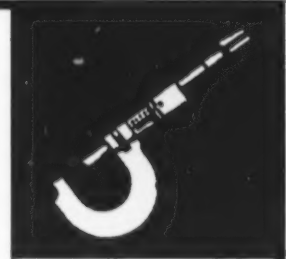
Tasks: State the safety concerns of operating an engine in an enclosed area
Explain the potential hazards of flammable material in proximity of exhaust systems
Explain environmental concerns regarding engine emissions and operation

Competency: Service exhaust systems

Tasks: Follow safety procedures
Diagnose exhaust system problems
Use service and repair manuals
Use special tools for servicing exhaust systems
Remove and replace exhaust system components
Inspect and clean exhaust ports and pipes

Engine Overhaul/Repair

(A) Indicates advanced competency or task



Competency: Understand engine overhaul

Tasks: Identify engine noises
Explain:

- a. conditions which cause engine oil consumption
 - b. cooling system problems
- Explain causes of engine failure such as:
- a. allowing dirt to get into engine
 - b. failing to check crankcase oil level often enough and letting engine run low on oil
 - c. overloading engine so it works too hard
 - d. running the engine too fast
 - e. failing to properly store engine during off season
 - f. timing
 - g. fuel mixture
 - h. air leaks

Competency: Disassemble engine

Tasks: Use tools appropriate for engine disassembly including:

- a. flywheel wrench
- b. flywheel holder
- c. flywheel puller
- d. valve spring compressor
- e. engine stand
- f. ring expander

Disconnect battery

Remove engine from vehicle

Mount engine on suitable stand

Drain all fluids from engine

Remove exterior components including:

- a. starter unit
- b. air cleaner and its mounting bracket
- c. exhaust pipe and muffler
- d. carburetor and intake manifold
- e. air shroud, blower housing baffles, and fuel tank
- f. flywheel
- g. magneto components
- h. valve cover

Disassemble engine and remove internal components including:

- a. head
- b. valves and springs
- c. reed valve assembly
- d. piston assembly
- e. rings from piston
- f. piston pin locks and pin
- g. crankshaft
- h. camshaft
- i. oil pump and governor assembly
- j. main and rod bearings

Clean all parts and dry for inspection and measurement
Inspect for surface damage to machine areas



Competency:

Service a cylinder

Tasks:

Use cylinder rebuilding tools including:

- a. measuring instruments
- b. deglazing tool
- c. cylinder vise support
- d. hone
- e. boring bar
- f. ridge reamer

Inspect cylinder examining for:

- a. cracks
- b. stripped threads
- c. broken fins
- d. scored and damaged cylinder walls
- e. sleeve separation
- f. taper and out of roundness

Competency:

Service the piston, rings, and connecting rod

Tasks:

Use tools including:

- a. outside micrometer
- b. telescoping gauge
- c. ring groove cleaner
- d. feeler gauges
- e. ring expander

Check piston connecting rod assembly visually for scoring wear spots and deformities

Disassemble piston/connecting rod assembly

Clean and compare measurements to manufacturers specifications

Check for ring groove wear and ring end gap

Inspect pin and connecting rod

Competency:

Service a crankshaft assembly

Tasks:

Use tools including:

- a. outside micrometer
- b. seal removal tools
- c. seal installation tools
- d. bearing pullers
- e. bearing installation tools

Measure crankshaft to manufacturer's specifications including:

- a. bearing journals and crank pin
- b. bearings and main seals

Competency:

Service a multi-piece crankshaft assembly

Tasks:

Use tools including:

- a. dial indicators
- b. inside micrometers
- c. outside micrometer
- d. bearing puller
- e. centering device
- f. vise
- g. soft hammer
- h. thickness gauge
- i. arbor press

Disassemble/reassemble crankshaft according to manufacturer's procedures and specifications



Competency:

Service a valve assembly

Tasks:

Use tools including:

- a. valve seat grinding equipment
- b. valve face grinding equipment
- c. outside micrometer
- d. telescoping gauge/small hole gauges
- e. valve spring tension tester
- f. valve seat removal tools
- g. valve seat driver
- h. valve guide removal tools
- i. valve guide reamers

Recondition valve face, seats, stems and guides

Disassemble/reassemble valve assembly according to manufacturer's procedures and specifications

Competency:

Reassemble the small engine

Tasks:

Use tools including:

- a. torque wrench
- b. gasket sets and sealants
- c. valve spring compressor
- d. ring compressor
- e. assembly lube
- f. ring expander
- g. engine manual
- h. plastigauge

Coat all metal surfaces with light weight oil before assembly

Install crankshaft in block

Assemble rod to piston with wrist pin

Check ring gap in cylinder

Install rings on piston in correct position

Install ring compressor on piston

Push piston into cylinder

Line rod in correct position on crankshaft

Install rod cap, oil slinger, and lock tabs

Torque rod bolts to correct specifications

Install tappets

Install camshaft and cam gear

Install oil slinger or oil pump

Install gasket on block assembly
Install sump bolts
Check end play of crankshaft
Install valves
Check valves for correct clearance
Install valve springs, valve cover, and valve cover gasket
Install air deflector shields
Install cam plunger, ignition points, and condensor
Gap points to correct setting when points fully open
Install point dust cover
Install flywheel and flywheel key, washer, and starter recoil mechanism
Install coil assembly and air vane governor assembly
Check cylinder head for warping
Install cylinder head gasket, cylinder head, and air deflector
Install shroud and flywheel cover and fuel tank
Install carburetor gasket, carburetor, governor linkage, and springs
Connect fuel lines and valve cover breather tube
Install muffler and lock nut
Install engine on equipment or implement
Connect remote throttle, belts, and other equipment
Fill crankcase with new oil
Install serviced air filter on carburetor
Fill fuel tank with fresh fuel
Install spark plug
Turn on fuel to carburetor
Make final adjustments
Start the engine



Troubleshooting and Maintenance



Competency: Diagnose engine malfunctions

Tasks:

- Troubleshoot mechanical conditions of the following:
 - a. cylinder head and valve train problems
 - b. block problems
 - c. intake manifold and carburetor pre-heat system
 - d. exhaust system
- Troubleshoot electrical circuit conditions of the following:
 - a. cranking circuit
 - b. charging circuit
 - c. conventional and electronic ignition systems
- Diagnose fuel system conditions including:
 - a. fuel storage, pumps, lines and filters
 - b. carburetor adjustments
- Perform running test including:
 - a. low speed operation
 - b. high speed operation
 - c. acceleration
 - d. ignition patterns
 - e. carburetor adjustment and power circuit
 - f. horsepower/rpm
 - g. vibrations

Competency: Service engines that have been submerged

Tasks:

- Explain terms and principles associated with engines that have been submerged such as:
 - a. chemical reaction with salt water
 - b. chemical reaction with fresh water
 - c. oxidation
- Leave the engine submerged until ready for immediate service
- Flush with fresh water
- Inspect engine
- Drain all fluids
- Blow dry
- Determine whether or not engine is operational
- Refer to manufacturer's specifications for running and/or for repair

Competency: Tune-up small engines

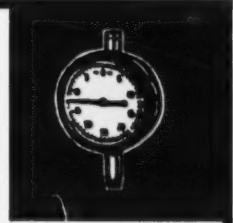
Tasks:

- Explain terms and principles associated with small engine tune-up such as:
 - a. point gap
 - b. proper air/fuel mixture
- Service and/or replace spark plugs
- Service and/or replace ignition points and condenser
- Check engine compression and/or cylinder leakage
- Service/replace distributor
- Adjust dwell and ignition timing
- Test and service battery and cables
- Set carburetor idle mixture and speed

Adjust linkages
Service spark arrestors and/or filter
Service and/or replace fuel filter
Inspect hoses and tighten all connections
Check and service lower unit oil
Test charging system circuit
Test cranking system circuit
Check and adjust ignition system
Use basic meters, including:

- a. ohmmeter
- b. ammeter
- c. voltmeter
- d. timing light/advance meter
- e. R.P.M. and dwell meter

Lube mechanical parts (steering, throttle, tilt)



Competency:

Install and break-in engine assembly

Tasks:

Explain terms and principles associated with break-in of engine assemblies such as:

- a. friction and wear
- b. seating of mechanical parts

Install as per manufacturer's instruction

Inspect engine fluid leaks and check oil pressure

Install muffler assemblies

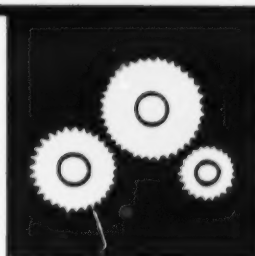
Perform final adjustments on:

- a. carburetor
- b. belts
- c. linkage
- d. dwell and timing
- e. fluid levels
- f. test cooling system

Replace protective guards on chains, gears, shafts, or flywheels before operating

Power Transmissions

(A) Indicates advanced competency or task



Competency: Understand transmissions

- Tasks:**
- Explain terms and principles associated with power transmissions such as:
 - a. gear ratios
 - b. fluid pressures and hydraulic systems
 - Explain the need for a transmission to keep an engine in its optimum power curve
 - Identify type and operation of the following transmissions:
 - a. belt drives
 - b. chain drives and sprockets
 - c. centrifugal clutches, flex couplings
 - d. variable torque converter
 - e. outboard lower units and sets
 - f. outboard propeller design
 - g. gear transmissions
 - h. hydraulic systems
 - (A) Calculate power requirements for a specific engine, including:
 - a. force
 - b. work
 - c. friction
 - d. torque
 - e. energy
 - f. kinetic energy
 - g. potential energy
 - h. power
 - i. horsepower
 - 1. brake horsepower
 - 2. indicated horsepower
 - 3. frictional horsepower
 - 4. rated horsepower
 - 5. corrected horsepower
 - j. electrical power (kilowatts)

Competency: Service transmissions

- Tasks:**
- Use service and repair manuals
 - Check alignment of pulleys and shafts
 - Remove/repair clutches and flex couplings
 - Inspect/repair chain drive system
 - Check belt tension and condition
 - Disassemble primary and secondary converter
 - Inspect/repair hydraulic systems fluid levels and leaks
 - Measure and/or adjust fluid level
 - Service hydraulic pumps and valve assemblies, hoses and filters
 - Rebuild drive
 - (A) Rebuild valve assembly

Competency: Overhaul outboard lower units, propeller, and trim tabs

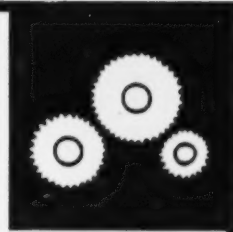
Tasks: Explain terms and principles associated with outboard lower units, propellers, and trim tabs including:

- a. pinion gears
- b. gear ratios
- c. pitch of propeller
- d. energy conversion
- e. high volume hydraulic pumps

Use service and repair manuals

Service/repair:

- a. jet units
- b. lower units
- c. propeller
- d. trim tabs



Competency: Service gear housing assembly components

Tasks: Inspect fluid levels and leaks
Inspect and adjust linkages
Inspect and torque mounting bolts
Inspect vacuum shift controls
Use special tools and equipment
Use service and repair manuals

Service and adjust/replace:

- a. clutch assembly
- b. linkage
- c. transmission
- d. differential
- e. lubricant levels and condition

(A) Overhaul/rebuild

- a. manual transmissions
- b. differentials

Competency: Service drive shaft components

Tasks: Explain terms and principles associated with servicing drive shaft components such as:

- a. energy conversion
- b. balance
- c. flexible couplings
- d. torque
- e. horsepower

Inspect and lubricate universal joints
Repair/replace constant velocity joint
Measure drive shaft angle and runout

Brakes and Safety

(A) Indicates advanced competency or task

(A) Competency: Service hydraulic brakes

Tasks: Explain terms and principles associated with hydraulic brakes
Replace discs and/or drums
Bleed brakes
Replace pads and/or shoes
Adjust shoes and peddle lever for proper free play
Rebuild master and slave cylinders

(A) Competency: Service mechanical brakes

Tasks: Explain terms and principles associated with mechanical brakes
Change cables and brake shoes
Adjust shoes
Adjust linkage for proper free play

(A) Competency: Service safety interlocks

Tasks: Explain terms and principles associated with safety interlocks
Troubleshoot with multimeter interlock switches
Replace switch
Adjust switch engagement

(A) Competency: Service chain saw brakes

Tasks: Explain terms and principles associated with chain saw brakes
Replace brake parts
Adjust brake for proper free play

(A) Competency: Service blade brakes

Tasks: Explain terms and principles associated with blade brakes
Troubleshoot and repair blade brake systems
Replace parts
Adjust brake for proper free play

Marine Engine and Boat Rigging



(A) Indicates advanced competency or task

(A) Competency: Understand motor installation

Tasks: Explain terms and principles associated with motor installation
Calculate:

- a. center of boat
- b. engine height

Install:

- a. steering system
 - 1. hydraulic
 - 2. mechanical
- b. remote control systems

(A) Competency: Service accessories

Tasks: Inspect steering mechanism, bushings or bearings, lowering mechanism:

- a. cables
- b. gears
- c. shafts

Refit and replace steering mechanism, bushings and bearings, steering, cables, gears, shafts

Remove and replace raising and lowering mechanism

Diagnose and repair deck mounting or transom mounting mechanism

(A) Competency: Understand corrosion protection and engine storage

Tasks: Explain terms and principles associated with corrosion protection and engine storage such as:

- a. oxidation
- b. electron flow
- c. electrolysis and protection devices
- d. surface protection

Remove, inspect and replace sacrificial anodes

Winterize engine

(A) Competency: Service propellers

Tasks: Select appropriate prop for a given marine package, including:

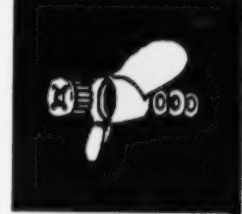
- a. selecting a prop from a manufacturer's prop chart
- b. testing prop
- c. changing tilt pin hole
- d. adjusting trim tab
- e. adjusting engine height

Test vessel on the water including:

- a. drivability of vessel
- b. engine operation
- c. safety features of vessel

(A) Competency: Perform finish repair

- Tasks:**
- Explain terms and principles associated with finish repair such as:
 - a. adhesion
 - b. solvents
 - c. catalytic reactions
 - Perform fiberglass/painting operations including:
 - a. selecting repair materials
 - b. repairing surface area
 - c. preparing surface area
 - d. preparing paint mixture
 - e. spraying paint surface



(A) Competency: Rig trailers

- Tasks:**
- Explain terms and principles associated with rigging of trailers including:
 - a. electrical current
 - b. resistance
 - c. grounding
 - d. insulation
 - e. corrosion
 - Perform trailer set-up including the inspection, assembly and maintenance of:
 - a. safety chains and couples
 - b. trailer winch
 - c. bow eye hook
 - d. cable or rope
 - e. ratchet lock
 - f. winch gears
 - g. mounting bolts
 - h. electrical lighting system
 - Inspect and adjust bunks and rollers including:
 - a. checking boat hull to trailer clearance
 - b. tightening all bunk fasteners
 - Inspect drum brake and wheel system including:
 - a. brakes
 - b. drums
 - c. linings
 - d. wheel cylinders/calipers
 - e. master cylinder
 - f. lines/hoses
 - g. control valves
 - h. surge brakes

(A) Competency: Service wheel bearings and seals

- Tasks:**
- Explain terms and principles associated with wheel bearings and seals including:
 - a. corrosion
 - b. friction
 - c. lubrication
 - Remove, inspect, pack/replace wheel bearings and seals

(A) Competency:

Install dash and bow accessories and components

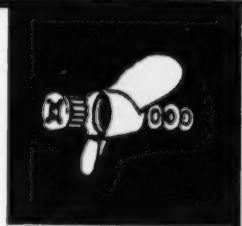
Tasks:

Explain terms and principles associated with installing dash and bow accessories and components such as:

- a. arrangement of components
- b. electrical/electronic concerns
- c. mechanics
- d. economics

Install accessories such as:

- a. circuit breaker and ground bar system
- b. speedometer
- c. tachometer
- d. horn and horn button
- e. depth indicator
- f. windshield wiper
- g. running lights
- h. spot light
- i. anchor
- j. voltmeter
- k. water pressure gauge
- l. trim gauge



IV
Course
Descriptions

Course Descriptions

These brief course descriptions provide a conceptual framework for the design and implementation of a balanced program in small engines and outboard marine mechanics. Teachers can use these descriptions to organize course offerings in small engines and outboard marine mechanics education. These descriptions are examples of content organization and are too brief for purposes of program approval. Local schools will need to provide more definition regarding the content of their courses than is reflected in these course descriptions.

Course: Small Engines and Outboard Marine Mechanics I
Length: One Year
Grades: 9-12

Small Engines and Outboard Marine Mechanics I is a course which provides students with introductory experience and basic skills in small engine and marine technology. This first course includes an introduction to: laboratory safety and shop procedures, tools and equipment, fundamentals of internal combustion engines, employability skills, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, marine engine and boat rigging.

Course: Small Engines and Outboard Marine Mechanics II
Length: One Year
Grades: 10-12

Small Engines and Outboard Marine Mechanics II is a course which provides students with intermediate level skills in all units taught in the introductory course. These units cover: laboratory safety and shop procedures, tools and equipment, fundamentals of internal combustion engines, employability skills, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, marine engine and boat rigging. Only those students who have successfully completed Small Engines and Outboard Marine Mechanics I should be enrolled.

Course: Small Engines and Outboard Marine Mechanics III
Length: One Year
Grades: 11-12

Small Engines and Outboard Marine Mechanics III provides students with advanced level training in: laboratory safety and shop procedures, tools and equipment, fundamentals of internal combustion engines, employability skills, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, marine engine and boat rigging. Only those students who have successfully completed Small Engines and Outboard Marine Mechanics I and II should be enrolled.

Course: Small Engines and Outboard Marine Mechanics IV
Length: One Year
Grades: 12

Small Engines and Outboard Marine Mechanics IV covers all of the skills required for entry-level small engines and marine mechanics occupations. This is a course which provides students with mastery level skills in: laboratory safety and shop procedures, tools and equipment, fundamentals of internal combustion engines, employability skills, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, marine engine and boat rigging. Only those students who have successfully completed Small Engines and Outboard Marine Mechanics I, II, and III should be enrolled in this senior-level.

V
**Curriculum
Analysis Matrices**

Curriculum Analysis Matrices

Identified Competencies by Course Offerings

This competency checklist should be used by teachers in identifying competencies to be included in specific classes in small engines and outboard marine mechanics education. This checklist is a curriculum analysis tool for use by teachers in assigning responsibilities for the competencies of a total small engines and outboard marine mechanics education program.

All courses taught in the small engines and outboard marine mechanics education program are identified in the columns at the top of the matrix. The individual competencies can be allocated to specific courses. One method for analyzing the competency list is to assign letters where the competency will be introduced (I), taught (T), or mastered (M). Curriculum sequences can be organized through this approach.

To assist mechanics teachers to reinforce basic skills instruction, competencies have been cross-referenced with the following academic areas:

Math (M)	Science (S)
Social Studies (SS)	Language Arts (LA)

This will assist local school districts in awarding cross-credit (academic credit) for participation in vocational classes they deem appropriate.

The following checklists are also cross-referenced with the Job Training Partnership Act pre-employment competencies and student leadership competencies. The Job Training Partnership Act provides funds to train economically disadvantaged youth to enter and succeed in employment. Each Private Industry Council responsible for administering these funds adopted youth pre-employment competencies as one of the measures for positive termination for program participants. The other measures are attained through unsubsidized employment, or through another training program.

The following categories of work-related knowledge must be evaluated and measured in the course of a participant's enrollment in a JTPA program:

1. Pre-Employment Competencies, which require the participant to demonstrate the skills and knowledge necessary to identify career objectives, seek and obtain employment and understand job performance.
2. Work Maturity Competencies, which require the participant to demonstrate the ability to apply skills in a training position.
3. Educational Skills Competencies, which require the participant to demonstrate basic computation and communication skills necessary to enter the labor market.
4. Occupational Skills Competencies, which require the participant demonstrate proficiency in those skills necessary to maintain employment in a specific occupation or occupational cluster.

The pre-employment and work maturity competencies have been specifically cross-referenced in this curriculum so that small engines and outboard marine mechanics instructors could specify where these competencies are integrated into the curriculum.

Student leadership programs are designed to be an integral part of the curriculum. The competencies are reinforced by student participation in approved student organizations such as Vocational Industrial Clubs of America. The student leadership competencies have been cross-referenced in this handbook to assist the small engines and outboard marine mechanics instructor in identifying specifically where these competencies will be taught.

Vocational Industrial Clubs of America (VICA)

Vocational Industrial Clubs of America (VICA) is for students enrolled in secondary and postsecondary vocational courses in trade, industrial, technical and health education.

Through planned club activities, VICA develops the "whole" student, social and leadership abilities as well as vocational skills. The VICA motto is "Preparing for Leadership in the World of Work." VICA goals include:

- Foster an understanding of the functions of labor and management organizations and a recognition of their interdependence.
- Foster respect for the dignity of work.
- Relate school experiences to a young person's search for meaning, identity and achievement.
- Teach young people how to live and work with others...to accept and be accepted.
- Offer activities that complement occupational skill development.
- Create interest in and stimulate favorable community response to trade, industrial, technical and health occupations education.
- Promote high standards in work ethics, craftsmanship, scholarship and safety.
- Help students understand their roles in a technological age.

Alaska VICA, chartered in 1973, serves about 140 members in 10 chapters. The national organization is located in Leesburg, Virginia.



KEY

M	Math
S	Science
LA	Language Arts
SS	Social Studies
*	Pre-Employment Competencies
+	Student Leadership Competencies

Recommended Competencies by Course Offerings

Competencies

		Small Engines and Outboard Marine Mechanics I	Small Engines and Outboard Marine Mechanics II	Small Engines and Outboard Marine Mechanics III	Small Engines and Outboard Marine Mechanics IV
	Employability Skills				
LA +	Make career choices				
LA + SS +	Evaluate jobs in the small engine and outboard marine mechanics industry				
LA +	Prepare a resume and job application				
LA +	Write a cover letter				
LA +	Prepare for an interview				
LA	Follow up the interview				
+	Dress appropriately on the job				
+	Manage personal responsibilities related to employment				
S	Maintain good health for effective job performance				
+	Understand employee rights and responsibilities				
LA	Deal effectively with customers				
LA +	Attain work maturity				
LA +	Solve problems				
+	Demonstrate initiative and productivity				
+	Be assertive				
+	Be honest				
+	Be reliable and dependable				
+	Maintain good personal relations				
LA	Apply reading and writing skills				
LA +	Follow verbal and written directions				
LA	Demonstrate on-the-job growth				

Recommended Competencies by Course Offerings

Competencies

		Small Engines and Outboard Marine Mechanics I	Small Engines and Outboard Marine Mechanics II	Small Engines and Outboard Marine Mechanics III	Small Engines and Outboard Marine Mechanics IV
* LA	Use proper job resignation procedures				
* +	Use leadership skills				
LA SS	Evaluate personal traits in relationship to entrepreneurship				
	<u>Laboratory Safety & Shop Procedures</u>				
LA S	Understand need for safety				
LA SS	Understand the organization of the laboratory				
LA SS	Use general safety procedures				
S	Use chemicals safely				
LA S	Use laboratory equipment safely				
LA S	Use tools safely				
SS	Maintain a clean shop				
LA SS	Follow OSHA guidelines				
LA S	Prevent work-related injuries				
LA S	Perform general shop duties				
M SS	Perform service and business procedures				
	<u>Tools and Equipment</u>				
M S	Use hand tools				
M S	Use power tools				
M S	Operate oxy-acetylene equipment				
M S	Use fasteners, gaskets, sealants, and adhesives				
S	Perform thread repair				
M	Use measuring devices				

Recommended Competencies by Course Offerings

Competencies

		Small Engines and Outboard Marine Mechanics I	Small Engines and Outboard Marine Mechanics II	Small Engines and Outboard Marine Mechanics III	Small Engines and Outboard Marine Mechanics IV	
M	Apply mathematics and measurement fundamentals					
	<u>Fundamentals of Internal combustion engines</u>					
S	Identify parts of small engine					
S	Understand engine classification and applications					
S	Understand the operation of the internal combustion engine					
S	Understand the operation of small diesel engines					
S	Understand engine operating systems					
S	Understand engine measurement and performance					
	<u>Engine Design and Structure</u>					
S	Understand the operation of the piston, connecting rod, and crankshaft assembly					
S	Understand the operation of the valve train					
S	Understand the operation of the two-stroke induction system					
S	Understand the function of the cylinder block assembly					
	<u>Cooling and Lubrication Systems</u>					
S	Understand engine cooling systems					
S	Service air cooling systems					
S	Service liquid cooling systems					
S	Inspect outboard water pumps					
S	Understand engine lubrication					
S	Service lubricating systems					
S	Service oil injection systems					
	<u>Fuel Systems</u>					

Recommended Competencies by Course Offerings

Competencies

		Small Engines and Outboard Marine Mechanics I	Small Engines and Outboard Marine Mechanics II	Small Engines and Outboard Marine Mechanics III	Small Engines and Outboard Marine Mechanics IV
S	Understand chassis lubrication and service				
S	Understand fuel systems				
S	Understand carburetor systems				
S	Service fuel systems				
S	Service speed control devices				
	<u>Electrical Systems</u>				
S	Understand electricity and magnetism				
S	Understand batteries				
S	Service batteries				
S	Understand charging systems				
S	Service charging systems				
S	Understand breaker ignition systems				
S	Service breaker ignition systems				
S	Understand the solid state ignition system				
S	Service solid state ignition systems				
S	Understand starting systems				
S	Service starting systems				
S	Service engine timing				
	<u>Exhaust and Emissions</u>				
S	Understand exhaust systems				
S	Understand safety and environmental concerns				
S	Service exhaust systems				

Recommended Competencies by Course Offerings

Competencies

		Small Engines and Outboard Marine Mechanics I	Small Engines and Outboard Marine Mechanics II	Small Engines and Outboard Marine Mechanics III	Small Engines and Outboard Marine Mechanics IV
	<u>Engine Overhaul/Repair</u>				
S	Understand engine overhaul				
S	Disassemble engine				
S	Service a cylinder				
LA M S	Service the piston, rings, and connecting rod				
LA M S	Service a crankshaft assembly				
LA M S	Service a multi-piece crankshaft assembly				
LA M S	Service a valve assembly				
LA M S	Reassemble the small engine				
	<u>Troubleshooting and Maintenance</u>				
S	Diagnose engine malfunctions				
S	Service engines that have been submerged				
S	Tune-up small engines				
S	Install and break-in engine assembly				
	<u>Power Transmissions</u>				
M S	Understand transmissions				
M S	Service transmissions				
S	Overhaul outboard lower units, propeller, and trim tabs				
LA S	Service gear housing assembly components				
M S	Service drive shaft components				
	<u>Brakes and Safety</u>				
S	Service hydraulic brakes				

Recommended Competencies by Course Offerings

Competencies

		Small Engines and Outboard Marine Mechanics I	Small Engines and Outboard Marine Mechanics II	Small Engines and Outboard Marine Mechanics III	Small Engines and Outboard Marine Mechanics IV	
S	Service mechanical brakes					
S	Service safety interlocks					
S	Service chain saw brakes					
S	Service blade brakes					
	<u>Marine Engine and Boat Rigging</u>					
M S	Understand motor installation					
S	Service accessories					
S	Understand corrosion protection and engine storage					
S	Service propellers					
S	Perform finish repair					
S	Rig trailers					
S	Service wheel bearings and seals					
S	Install dash and bow accessories and components					

VI
Sample
Skills Card

Sample Skills Card

This section of the guide provides teachers with an example of an instrument for evaluating the effectiveness of instruction. The skills record allows teachers to assess competency at four levels of proficiency. Teachers are encouraged to construct their own skills performance record using the competency lists in the curriculum section of this guide.

Instructions for Use

The list of vocational skills/traits was developed from a task analysis of a small engines and outboard marine mechanics competency.

Level

Code Key

- | | |
|---|--|
| 1 | <u>Introductory Level:</u> Can do simple parts of task. Needs to be told/shown how to do most of the task. Needs extremely close supervision. |
| 2 | <u>Minimum Level:</u> Can do most parts of the task. Needs help only with most difficult parts. Needs close supervision. |
| 3 | <u>Average Level:</u> Can do all parts of task. Needs only spot-check of completed work. Meets local demands for speed and accuracy. Needs moderate job entry supervision. |
| 4 | <u>Proficiency Level:</u> Can complete task quickly and accurately. Can direct others in how to do the task. Needs little supervision. |

Directions: The instructor/employer may write, date and initial in appropriate square.

Perform thread repair

1	2	3	4

Chase threads

Extract broken fasteners

Drill and tap holes

(A) Repair damaged threads using a thread repair procedure

Comments:

VII Suggested Resources

Suggested Resources

This section identifies specific resources and sources for finding instructional materials and supplies for small engines and outboard marine mechanics.

The following source lists have been characterized by media type to facilitate teacher use: resource libraries, publishers of texts and instructional materials, state resources, associations, periodicals, special books/pamphlets, media, and materials suppliers. A comprehensive tools and equipment list is provided at the end of this section.

The Alaska Department of Education has not formally reviewed nor approved all the resources listed in this section. Teachers are encouraged to preview materials before using them in the classroom.

Resource Libraries

Alaska Vocational Materials Library
Office of Adult & Vocational Education
Alaska State Department of Education
Box F
Juneau, AK 99811
(907) 465-2980

- Alaska Energy Education Series
- Appropriate Technology for Alaskans
- Basic Skills For The Trades
- Choices & Challenges: A Young Man's and Teen Woman's Journal for Self-Awareness and Personal Planning
- Cooperative Education and On-The-Job Training Handbook
- Engine and Vehicle Mechanics Curriculum
- Home-Based Business Resources
- Industrial Education Curriculum
- Industrial Education Resources
- Introduction to Marine Technology
- Local Advisory Committee: Handbook for Vocational Administrators
- Pre-Employment Competencies Resource Guide
- Safety and School Shop Planning
- Snowmobile Repair
- STARS: Secondary Training For Alaska
- Vocational Education Administration Handbook

The Library maintains curricula for all vocational areas. Resources are loaned for a 2 month review period. There are also many materials which may be purchased from the Library's special collections. Some materials are available free of charge.

The Library's catalog is computerized and may be operated on an Apple Computer using Appleworks software. The catalog may be obtained by sending five blank disks for duplication or upon request.

Alaska Career Information System
Office of Adult and Vocational Education
Alaska Department of Education
Box F
Juneau, AK 99811
(907) 465-2980

- Comprehensive career guidance system developed by Alaskans and for Alaskans seeking occupational and educational opportunities in and out of Alaska.

Alaska Health Sciences Library
3211 Providence Dr.
Anchorage, AK
(907) 786-1870

- Journals and magazines in the area of job safety and health

Alaska State Film Library
650 W International Airport Road
Anchorage, AK 99518
(907) 561-1132

Curriculum Collection
Alaska Department of Education
Office of Educational Program Support
Box F
Juneau, AK 99811
(907) 465-2841

Northwestern Vocational Curriculum
Coordination Center
St. Martin's College
Lacey, WA 98503
(206) 438-4456

National Center for Research in
Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, OH 43210

Publishers

American Technical Publishers, Inc.
12235 South Laramie Ave.
Alsip, IL 60658

Bobbs-Merrill Publishing Co.
4300 W 62 St.
P.O. Box 7080
Indianapolis, IN 46206

Briggs and Stratton Engine Corporation
2711 North 13 St.
Milwaukee, WI

Chilton Book Company
Chilton Way
Radnor, PA 19089

Clymer Publications
P.O. Box 4520
Arleta, CA 91333

Dana Corporation
School Assistance
Box 453
Toledo, OH 43692

Deere and Co.
John Deere Road
Moline, IL 61265

- Films on small engines and marine mechanics
- Village Science: A Resource Handbook for Rural Alaskan Teachers
- 10-state regional library of vocational materials. Can be accessed through the Alaska Vocational Materials Library.
- Vocational Education Curriculum Materials database of all 50 states. Can be accessed through the Alaska Vocational Materials Library.
- Catalog of materials available on new technology in vocational-technical education.

Goodheart-Wilcox Co., Inc.
123 W Taft Dr.
South Holland, IL 60473

Gregg Division/McGraw-Hill Book Co.
8171 Redwood Highway
Novato, CA 94947
(415) 897-5298

Intertec Publishing Corp
Box 12901
Overland Park, KS 66212
(913) 888-4664

Mitchell Information Services, Inc.
9889 Willow Creek Rd.
Box 26260
San Diego, CA 92126

National Textbook Company
4255 W. Touhy Ave.
Lincolnwood, IL 60646

Prakken Publications
P.O. Box 8623
Ann Arbor, MI 48107

Prentice-Hall Publishing Co.
Educational Books Division
Englewood Cliffs, NJ 07632

Delmar Publishers
2 Computer Dr. West
Albany, NY 12212

Glencoe Publishing Co.
Bennet and McKnight
17337 Ventura Blvd.
Encino, CA 91316

JIST Works, Inc.
150 East 14th Street
Indianapolis, IN 46202

State Resources

Alaska Department of Labor
Occupational Safety and Health
3301 Eagle St.
P.O. Box 7022
Anchorage, AK 99501

Alaska Vocational Technical Center
Box 889
Seward, AK 99664

Curriculum Development Unit
Office of Vocational Education
2024 Capital Plaza Tower
Frankfort, KY 40601
(502) 564-2890

Curriculum Publications Clearinghouse
Western Illinois University
Horrabin Hall Y6
Macomb, IL 61455
(309) 298-1917

District of Columbia Public Schools
Division of Career Development Programs
Washington, DC

Educational Instructional Materials Center
University of Texas at Austin
P.O. Box 7218
Austin, TX 78713-7218
(512) 471-7716

Florida Department of Adult and
Vocational Education
College of Education
University of South Florida
Tampa, FL 33620

South-Western Publishing Co.
5101 Madison Rd.
Cincinnati, OH 45227

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

TAB Books
PO Box 40
Blue Ridge Summit, PA 17214-9989

- Provides free information, training and inspections
- Orientation to Mechanics
- Instructional modules on small engines and repair mechanics
- Microcomputer Applications in Vocational Education: Trades and Industry
- Vocational-Technical Education Consortium of States (V-TECS) catalogs of performance objectives and curriculum guides for small engines and mechanics
- Competency-Based Curriculum on Small Engine Repair Grades 10-12
- Maintenance Equipment Mechanic
- Motorboat Mechanic
- Motorcycle Mechanic
- Florida Vocational Program Guide to Basic Marine Mechanics

Instructional Materials
Industrial Education
202-B Skyland Blvd.
Tuscaloosa, AL 35405
(205) 759-5448

Instructional Materials Laboratory
10 Industrial Education Building
University of Missouri-Columbia
Columbia, MO 65211
(314) 882-2883

Instructional Materials Service
Trade and Industrial Education
Texas A&M University
FE Box 2588
College Station, TX 77843-2588
(409) 845-6601

The Media Center
State Fair Community College
1906 Clarendon Rd.
Sedalia, MO 65301
(816) 826-7100

Michigan Vocational Education Resource
Center
133 Erickson Hall
Michigan State University
East Lansing, MI 48824
(517) 353-4397

Mid-America Vocational Curriculum
Consortium (MAVCC)
1500 W Seventh Ave.
Stillwater, OK 74074
(405) 377-2000

Minnesota Curriculum Services Center
3554 White Bear Ave.
White Bear Lake, MN 55110
(612) 770-3943

Occupational Curriculum Laboratory
East Texas State University
Commerce, TX 75428
(214) 886-5624

- Curriculum Standards for Small Engine Trade and Repair

- Diesel Repair
- Maintaining Small Engines
- Service and Repair of Small Engines
- Small Engines Series

- Mechanics Series

- Instructional modules including student and teacher guides, slide-tape or video presentations on mechanics

- Small Engine Repair and Related Equipment Repair Competencies and Tasks

- Chain Saw Repair
- Comprehensive Small Engine Repair
- Diesel Mechanics Series
- Motorcycle Repair
- Outboard Power Equipment Repair
- Outboard Repair
- Parts Specialist
- Small Engine Series
- Snowmobile Repair

- A Course on Alcohol Fuels
- Marine Task List
- Small Engines Marine Terminal Performance Objectives
- Small Engines Task List
- Teaching Aids and Competency-Based Education Modules

- General Mechanical Repair

Oregon Career Development Consortium
Marion Education Service District
651 High St. NE Suite 4
Salem, OR 97301
(503) 378-7470

South Carolina Department of Education
Columbia, SC 29201

Superintendent of Public Instruction
Office of Trade, Industrial, Technical and
Health Occupations
Division of Vocational/Technical Education
Old Capitol building, MS FG111
Olympia, WA
(206) 753-5675

Vocational Curriculum Development and
Center
P.O. Box 1159
Natchitoches, LA 71458-1159
(318) 352-5348

Vocational Instructional Materials Laboratory
1885 Neil Avenue Room 112
The Ohio State University
Columbus, OH 43210

Vocational Studies Center
University of Wisconsin-Madison
Publications Unit
265 Educational Sciences Building
1025 W. Johnson Street
Madison, WI 53706

Associations

American Association for Vocational
Instructional Materials (AAVIM)
120 Driftmeir Engineering Center
Athens, GA 30602
(404) 542-2586

- Basic Skills in Vocational Education: Computer Skills, Mathematics, Reading, Speaking/Listening, Writing

- Small Engine Repair Course Competencies

- Job Standards for Air Cooled Gasoline Engine Repair

- Small Engine Mechanics and Marine Operations

- Task Analysis for Small Engine Mechanic

- Small Business and Entrepreneurship Series

- Assisting Students in Improving Their Basic Skills
- ATV Maintenance Manual
- Care and Operation of Small Gasoline Engines
- Diesel Engine Repair
- Developing Shop Safety
- Electric Motors
- Fuels and Lubricants
- Inboard Engines and Drives I, II
- Inboard/Outboard Service
- Outboard Motor Flat Rate Manual
- Outboard Motor Service Manual I, II
- Small Air Cooled Engines Service Manual
- Small Diesel Engines Service Manual
- Small Engine Flat Rate Manual
- Small Gas Engine Part Identification
- Small Engines Maintenance and Repair
- Snowmobile Service Manual
- Snowthrower Service Manual

American Gear Manufacturers Association
1500 King St., Suite 201
Alexandria, VA 22314
(703) 684-0211

- AGMA Standards
- Monthly News Digest

American National Standards Institute
1430 Broadway
New York, NY 10018
(212) 354-3300

- Catalog of Standards

American Petroleum Institute
1220 L St. NW
Washington, DC 20005

- How To Sell Motor Oil
- Motor Oil Guide

American Society of Lubrication Engineers
838 Busse Highway
Park Ridge, IL 60068
(312) 825-5536

- Lubrication Engineering
- ASLE Transactions

American Society for Testing and Materials
655 15 St. NW
Washington, DC 20005
(202) 639-4025

- Book of ASTM Standards
- Standardization News

American Technical Society
848 E 58th St.
Chicago, IL 60637

- Fuel and Ignition Systems

American Vocational Association (AVA)
1410 King St.
Alexandria, VA 22314

- Catalog of resources for vocational educators

Boating Industry Association
333 North Michigan Ave.
Chicago, IL 60601

- Marine Service Manual of Recommended Practices

Engine Service Association, Inc.
710 N Plankinton Ave.
Milwaukee, WI 53202
(414) 271-2263

- Provide vocational education services for those involved in sales and service of internal combustion engines and engine powered equipment

Instrument Society of America
P.O. Box 12277
Research Triangle Park, NC 27709
(919) 549-8411

- Publications and Training Aids Catalog

National Marine Manufacturers Association
Boating Industry Association
401 N. Michigan Ave.
Chicago, IL 60611
(312) 836-4747

- Publishes booklets on marinas, statistics, boating writer's information guide, boating laws and a film directory

National Occupational Testing Institute
318 Johnson Hall
Ferris State College
Big Rapids, MI 49302
(616) 796-4695

- Small Engines Performance Test

Society of Automotive Engineers
400 Commonwealth Dr.
Warrendale, PA 15096
(412) 776-4841

Tune-Up Manufacturers Institute
222 Cedar Lane
Teaneck, NJ 07666
(201) 836-9500

Vocational Industrial Clubs of America
(VICA)
P.O. Box 3000
Leesburg, VA 22075

Periodicals

American Industrial Arts Association
1914 Association Dr.
Reston, VA 22091

American Vocational Association
1410 King St.
Alexandria, VA 22314

Fawcett Publications
1515 Broadway
New York, NY 10036

National Association of Trade and Technical
Schools
2251 Wisconsin Avenue NW Suite 200
Washington, DC 20087

Petersen Publishing Co.
8490 Sunset Blvd.
Los Angeles, CA 90069

Prakken Publications
P.O. Box 8623
Ann Arbor, MI 48107

Special Books/Pamphlets

American Honda Motor Company, Inc.
PO Box 50
100 W. Alondra Blvd.
Gardeno, CA 90247-0805

Champion Spark Plug Co.
900 Upton Ave.
Toledo, OH 43661
(419) 535-2567

- Air Cleaner Test Code
- Combustion Chamber Deposition and Power Loss
- Engine Varnish and Sludge
- Factors Affecting Piston Ring Life
- Handbook of Standards
- SAE Quarterly Transactions
- The Where and Why of Engine Reports
- Tune-Up Manual

- Advisor Guide
- National Leadership Handbook

- The Technology Teacher

- Vocational Education Journal

- Mechanix Illustrated

- Career Training Journal

- Motor Trend

- School Shop

- Educational materials (audiovisual)
- Periodicals
- Shop Manuals

- Facts About Spark Plugs and Engines

Chrysler Motors Corporation
Service Training
26001 Lawrence Ave.
Center Line, MI 48015

Clymer Publications
12860 Muscatine St.
P.O. Box 20
Arleta, CA 91331

Cooperative Extension Service
University of Alaska
WWB-6 Bunnell Building
303 Tanana Dr.
Fairbanks, AK 99701
(907) 479-7268

Ford Motor Co.
3000 Schaefer Rd.
Dearborn, MI 48121

General Motors Corporation
Public Relations Staff
General Motors Bldg.
Detroit, MI 48202

Howard Sams, Inc.
4300 W 62nd St.
P.O. Box 7080
Indianapolis, IN 46206

HP Books
PO Box 5367
Tucson, AZ 85703
(602) 888-2150

National Institute for Occupational
Safety and Health
Regional Office
321 Second Ave.
Seattle, WA
(206) 442-0530

National Safety Council
444 North Michigan Ave.
Chicago, IL 60611
(312) 527-4800

Pathfinder Publications, Inc.
108 Moss Ave.
Boston, MA 02123

Quaker State Oil Refining Corp.
255 Elm St.
Oil City, PA 16301
(814) 676-7676

- Carburetion Facts and Fundamentals
- Carburetion Fundamentals
- Mechanical Information

- Clymer's Honda ATC Repair Manuals

- Small Engine Storage

- Service Training Aids Catalog

- The ABC of Hand Tools

- Outboard Motors and Boating
- Small Gasoline Engines
- Small Gasoline Engine Repairman

- How to Rebuild Engines books

- Research and technical assistance, information and publications for all areas of job safety and health

- Accident Prevention Program for School Shops
- Safe Worker

- The Incredible Illustrated Tool Book

- Motor Oils and Engine Lubrication

S-A Design Books
515 West Lambert, Bldg E
Brea, CA 92621

Tecumseh Products Co.
Ottawa and Patterson Streets
Tecumseh, MI 49286
(517) 423-8411

Theodore Audel and Co.
4300 W 62nd St.
Indianapolis, IN 46268

Media

Bergwall Productions, Inc.
106 Charles Lindbergh Blvd.
Uniondale, NY 11553

Career Aids, Inc.
20417 Nordhoff St. Dept. D5
Chatsworth, CA 91311
(818) 341-8200

Color Film Corporation
Video Division
770 Connecticut Ave.
Norwalk, CT 06854
(203) 886-2711

Dana Corporation
Educational Assistance
P.O. Box 453
Toledo, OH 43692

DCA Educational Products
4685 Stenton Ave.
Philadelphia, PA 19144

DRW Educational Systems
PO Box 2941
Costa Mesa, CA 92628-2941

Education Associates, Inc.
P.O. Box Y
Frankfort, KY 40602

Ford Service Division
3000 Schaefer Rd.
Dearborn, MI 48121

- Bolt-On Performance
- Ford Performance
- Holley Carburetors
- Mopar Performance
- Performance with Economy
- Super Power

- Four Stroke Cycle Engine Mechanic's Handbook
- Mechanics Handbook: Light and Medium Frames

- Audel's Outboard Motors and Boating

Meridian Education Corporation
608 E. Locust St.
Bloomington, IL 61701
(309) 827-5455

National Audiovisual Center
8700 Edgeworth Dr.
Capitol Heights, MD 20743
(301) 763-1896

National Innovative Media Co.
Route #2 Box 301 B
Calhoun, KY 42327
(502) 273-5050

Nationwide Computer and Video
P.O. Box 61E
Morrisville, PA 19087
(215) 295-0055

Pictures, Inc.
811 W. 8th Ave.
Anchorage, AK 99501
(907) 279-1515

Teaching Aids, Inc.
P.O. Box 1798
Costa Mesa, CA 92628-0798

Technovate, Inc.
910 SW 12th Ave.
Pompano Beach, FL 33060

TPC Training Systems
P.O. Box 1030
Barrington, IL 60010
(312) 381-7015

Guidance Associates
90 South Bedford Road
Mt Kisco, NY 10549
(914)666-4100

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112
(612) 633-3170

Materials Suppliers

Allen Test Products Division
2101 N Pitcher St.
Kalamazoo, MI 49007

Ammco Tools, Inc.
Wacker Park
North Chicago, IL 60064

Bacharach, Inc.
625 Alpha Dr.
Pittsburgh, PA 15238

Bob Kerr's Marine Tool Co.
P.O. Box 1135
Winter Garden, FL 32787

Brodhead-Garrett Co.
4560 E 71st St
Cleveland, OH 44105
(800) 321-6730

Clayton Associates, Inc.
P.O. Box 589
Farmingdale, NJ 07727

Deere and Co.
John Deere Road
Moline, IL 61265

Eagle Manufacturing Co.
24th and Charles St.
Wellsburg, WV 26070

FMC Corporation
Auto Service Equipment Division
Industrial Park
Conway, AR 72032

Ken Cook Education Systems
12855 West Silver Spring Dr.
Butler, WI 53007

U.S. Environmental Protection Agency
TSCA Assistance Office TS-799
401 M St. SW
Washington, DC 20460
(202) 554-1404

Vocational Media Associates
Prentice-Hall Media
Box 1050
Mt. Kisco, NY 10549

Mac Tools, Inc.
P.O. Box 370
Washington Court House, OH 43160

Miller Special Tools
32615 Park Lane
Garden City, MI 48135

Niffisk of America
300 Technology Dr.
Malvern, PA 19355

Paxton/Patterson
5719 W 65th St.
Chicago, IL 60638

Rotary Lift
A Dover Industries Company
P.O. Box 30205, Airport Station
Memphis, TN 38130

Satco, Division of Saterlee
924 S 19th Ave.
Minneapolis, MN 55404

Sears Contract Sales
Sears Roebuck and Co.
19th Floor, Sears Tower
Chicago, IL 60684

Snap On Tools
Industrial Sales
3300 Knik Ave.
Anchorage, AK

S-T Industries, Inc.
301 Armstrong Blvd.
St. James, MN 56081

Sun Electric Corp.
One Sun Parkway
Crystal Lake, IL 60014

Kleer-Flo Co.
15151 Technology Drive
Eden Prairie, MN 55344

Northwest Sales Group
5718 1st Ave. S.
Seattle, WA 98108
(206) 762-5111

Wear Corporation
PO Box 80312
Seattle, WA 98108

ZEP Manufacturing Co.
18417 Cascade Ave. S.
Seattle, WA 98188
(206) 248-1900

Zip-Penn
3633 Seaport Blvd
P.O. Box 15129
Sacramento, CA 95851
(916) 372-7410

Tools and Equipment List

The following details tools and equipment used by small engine and outboard marine mechanics. This list is not inclusive.

Special Tools

1 Piston Groove Cleaner
1 Piston Ring Compressor
1 Ridge Reamer
2 Piston Ring Expanders
1 Valve Spring Compressor
1 Valve Refacing Lathe
1 Cylinder Gauge
1 Valve Seat Grinding Set
2 Cylinder Hones
1 Telescope Gauge Set
Machinists Files
1 Micrometer Set
1 Spark Plug Tap Set
1 Tachometer
1 Ignition Analyzer and CAP Disc. Adapter
2 Strap Wrenches
2 Hex Key Wrench Sets
1 Retaining Ring Plier Set
2 Putty Knives
4 Adjustable Wrenches (2 ea, 6", 10")
2 Torque Wrenches
2 Pipe Wrenches 10"
1 Rod Alignment Tester
1 Neway Valve Set Cutter Set
1 Grease Gun
2 Oilers
1 Ball Pein Hammer 12 oz.
1 Brass Hammer
1 Rubber Mallet
1 Soft Face Hammer 16 oz.
1 Brush (For Parts Cleaning)
2 Wire Brushes

Master Timing Set
Visual Timing Tester
Disc Brake Indicator Set
Scribers
Compression Tester Gauge
Ignition Point Files
Metric Drill Bit Set, 19 pieces
1 Crank Case Vacuum Tester
1 3/8" Sq. Drive Socket Set Std. 20 pieces
1 Comb Box/Open End Wrench Set 12 pieces
1 Open End Wrench Set, 7 pieces
10 Offset Box Wrenches
10 12 pt. Box Wrenches
10 Open End Wrenches
19 Comb. Box & Open End Wrenches
11 1/4" Sq. Drive Sockets
3 Ratchets
2 Hinge Handles for Ratchet
8 Extensions for Ratchet
2 Universal Joints for Ratchet
Safety Glasses
1 Spark Plug Socket
15 3/8" Drive Sockets
7 3/8" Drive Univ. Joint Sockets
1 4 oz. Ball Pein Hammer
1 8 oz. Ball Pein Hammer
1 Universal Gauge
1 Feeler Gauge
1 Comb. Ignition & Spark Plug Gauge
12 Asst. Wrenches and Snips
1 Set Ball Hone
1 Tap and Die Set Metric Standard

1 Soldering Gun
 1 Spark Plug Gauge Set
 1 Flaring Tool
 1 Tubing Cutter
 1 Thread Repair Kit
 Battery Pliers
 32 Assorted Screwdrivers with Key Rings
 1 Puller Set with Attachments
 1 Battery Hydrometer
 Belt Tension Gauge
 Brake Spoon
 Battery Post Cleaner
 Creeper
 Files -10" Coarse, 6" Fine
 Mechanics Steel Ruler
 1/4" and 1/8" pin punch
 3" center punch
 Screw Pitch Gauge - N.F., N.C., Metric
 Spark Plug Wire Remover
 Thread Chaser Set
 Tool Box

Tubing Wrenches
 Vernier Caliper
 Hacksaws
 Torx Screwdrivers
 1 Tube Bender
 18 Assorted Pliers
 1 Punch and Chisel Set (44 pieces)
 1 Complete Socket Set (122 pieces) 1/2"
 1 Adv. Reamer Set 3/8" to 1 5/16"
 Battery Nut Pliers
 Battery Terminal Clamp Puller
 Blow Gun — Rubber Tip (OSHA approved)
 Filter Wrench - Oil and Gas
 Magnetic Pickup Tool
 Oil Can - Pump Type
 3/8" taper punch
 Scraper - 1 1/2" wide
 Screw Starter - Standard and Phillips
 Tape Measure
 Tire Pressure Gauge
 Wire Brush

Special Equipment

1 Valve Grinder
 2 Small Engine Test Stands
 2 Outboard Motor Stands
 1 Battery Charger
 1 Outboard Test Tank
 1 ACTY Torch Set
 1 Drill Press
 1 Machinists Vice
 1 Bench Grinder
 1 1/2" Variable Speed Drill Motor
 1 3/8" Drill Motor
 1 1/2" Impact Wrench
 1 Hydraulic Press (Arbor Press)
 1 Parts Cleaning Tank
 1 Steam or Detergent Cleaner